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4.13 Test of Henry's Law Species

4.13.1 Air movement through stagnant water

This test verifies that FEHM has correctly implemented Henry's law solutes for air moving through a stagnant fluid phase. Figure 53 shows that FEHM results are in good agreement with the analytical solution. The results, compared numerically to the analytical solution (found in file *henry1_out.analyt*), are given in Table 55. The maximum absolute error for cases 1-1, 1-2, and 1-3 was less than 0.0027, and the percent errors were less than 3% for concentrations greater than 0.1. These results meet the acceptance criteria for this test suite developed in Chapter III.

Table 55. Results of the test of Henry's Law species

V&V test	Maximum error	Maximum % error	RMS error
Concentration versus time at the outlet node			
1-1	0.2594e-02	1.877	0.2024e-03
1-2	0.2615e-02	2.144	0.2336e-03
1-3	0.2583e-02	2.122	0.2309e-03
2-1	0.3281e-02	6.645	0.3447e-03
2-2	0.2837e-02	4.858	0.2306e-03
2-3	0.2910e-02	4.927	0.2358e-03
3-1, species 1	0.8266e-03	7.030	0.1795e-03
Final concentration at the outlet node			
3-1, species 2	0.8190e-03	0.2158	0.2158e-02
3-2, species 1	0.5993e-03	0.1579	0.1579e-02
3-2, species 2	0.3797e-03	0.1000	0.1000e-02
3-3, species 1	0.1727e-03	0.4549e-01	0.3164e-03
3-3, species 2	0.4240e-03	0.1117	0.7845e-03

4.13.2 Water movement through stagnant air

This test verifies that FEHM has correctly implemented Henry's Law solutes for water moving through a stagnant air phase. Figure 54 shows that FEHM results are in good agreement with the analytical solution. The results, compared numerically to the analytical solution (found in file *henry2_out.analyt*), are given in Table 55. The maximum absolute error for cases 2-1, 2-2, and 2-3 was less than 0.0033, and the percent errors were less than 7% when concentrations were greater than 0.1. These results meet the acceptance criteria for this test suite developed in Chapter III.

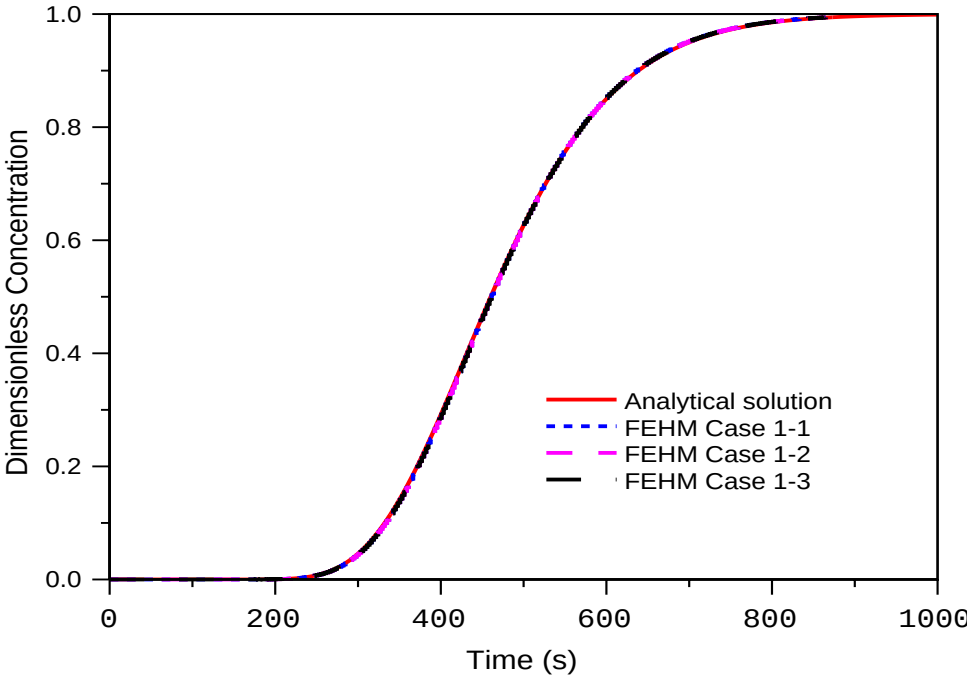

Figure 53. Comparison of FEHM results with the analytical solution for a mobile air phase.

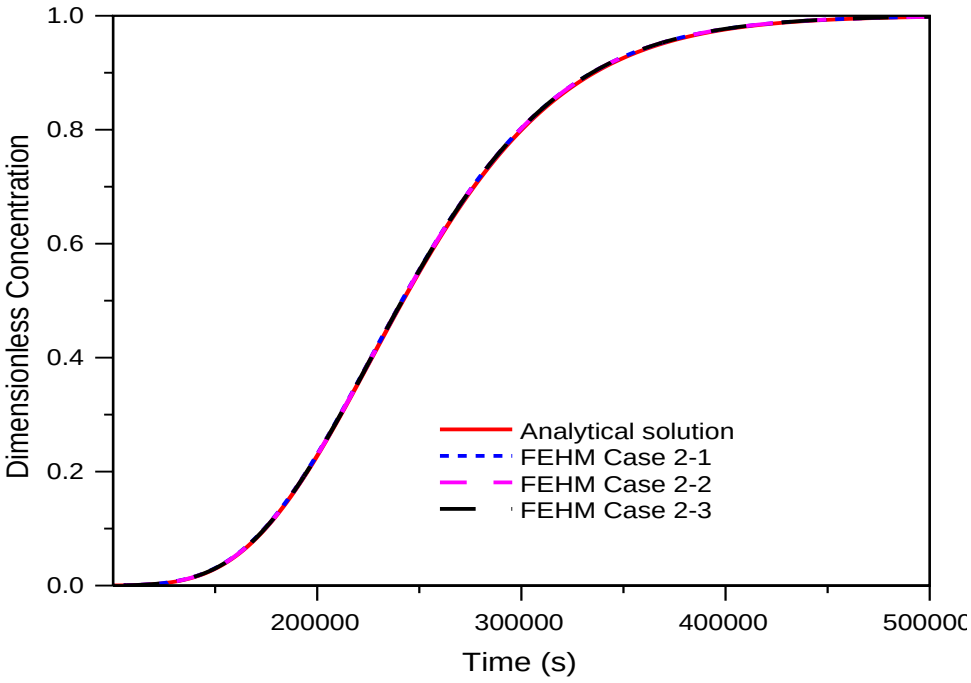

Figure 54. Comparison of FEHM results with the analytical solution for a mobile water phase.

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4.13.3 Air/water movement through stagnant water/air with chemical reaction

This test verifies that FEHM has correctly implemented Henry's Law solutes that may sorb or undergo chemical reaction. Figure 55 shows that FEHM results are in good agreement with the analytical solution, i.e., for case 3-1, species 1, the breakthrough curve appears the same as the analytical solution. The results, compared numerically to the analytical solution (found in file *henry3_out.analyt*), are given in Table 55. The maximum absolute error for case 3-1, species 1, was less than 0.00083, and the percent error was less than 8% when concentrations were greater than 0.1. The maximum absolute error for cases 3-1, 3-2, and 3-3 for the final concentration was less than 0.00082, and the percent errors were less than 0.3%. It should be noted for these cases that the RMS error is essentially a single point average. These results meet the acceptance criteria for this test suite developed in Chapter III.

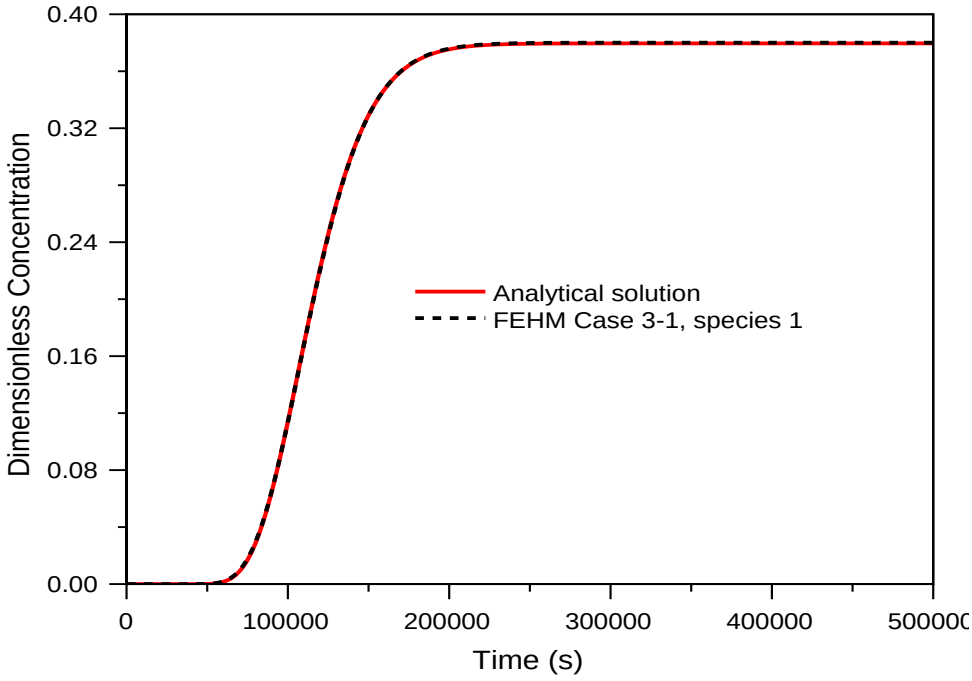

Figure 55. Comparison of FEHM results with the analytical solution for a mobile water phase with reactions.